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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>5</sup> :</b> A23L 1/236, 1/09, A23D 7/00 A23D 9/00, A23G 3/00	<b>A1</b>	<b>(11) International Publication Number:</b> WO 94/09649 <b>(43) International Publication Date:</b> 11 May 1994 (11.05.94)
<b>(21) International Application Number:</b> PCT/US93/10135 <b>(22) International Filing Date:</b> 22 October 1993 (22.10.93) <b>(30) Priority data:</b> 968,927 30 October 1992 (30.10.92) US <b>(71) Applicant:</b> HERSHEY FOODS CORPORATION [US/ US]; 100 Crystal A Drive, Hershey, PA 17033-0810 (US). <b>(72) Inventors:</b> ST. JOHN, James, F. ; 1585 Brookline Drive, Hummelstown, PA 17036 (US). FETTERHOFF, John, G. ; 1550 Doubling Gap Road, Newville, PA 17241 (US). CARPENTER, John, R. ; 305 Candlewick, Her- shey, PA 17033 (US). BROWN, B., Douglas ; 988 W. Areba Avenue, Hershey, PA 17033 (US). AZZARA, C., Daniel ; 35 Valley Drive, Annville, PA 17003 (US). TAR- KA, Stanley, M., Jr. ; 104 Harvey Road, Hershey, PA 17033 (US). RANK, Craig ; 205 Berry Drive, Harrisburg, PA 17112 (US). STROHMAIER, George, K. ; 2044 Southpoint Drive, Hummelstown, PA 17036 (US).		<b>(74) Agents:</b> SCOTT, Anthony, C. et al. ; Scully, Scott, Murphy & Presser, 400 Garden City Plaza, Garden City, NY 11530 (US). <b>(81) Designated States:</b> AT, AU, BB, BG, BR, BY, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> REDUCED FAT CONFECTIONERY PRODUCTS AND PROCESS  <b>(57) Abstract</b>  The present invention relates to a lowfat confection comprising a chocolate of full fat texture, said chocolate comprising a fat or fat substitute present in 20.0-24.5 % (w/w), and nonfat solids comprising nutritive carbohydrate sweetener, nonfat cocoa solids and an edible emulsifier. The present invention further relates to a process for producing a lowfat chocolate and more specifically, to the process of preparing and formulating said product compositions.		

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**REDUCED FAT CONFECTIONERY PRODUCTS AND PROCESS**

1           This invention relates generally to food product  
compositions, and more particularly to confectionery  
products, especially chocolate and chocolate-type  
5 products containing a nutritive carbohydrate sweetener,  
a fat or reduced calorie fat or combination thereof, and  
an edible emulsifier or surfactant, wherein the fat  
content is 20-24.5% by weight. In addition to the  
lowfat content, the food products of the present  
10 invention have rheology characteristics which are fully  
acceptable for moulding, enrobing and extruding  
operations. The present invention also relates  
generally to a process for producing a lowfat chocolate  
and more specifically, to the process of preparing and  
15 formulating said product compositions, e.g.,  
confectionery products, especially chocolate and  
chocolate-type products having fat or reduced calorie  
fat content or combination thereof, in which the total  
fat or reduced calorie fat content can be as low as 20%.

20           Food products made from ingredients including a  
carbohydrate sweetener such as sucrose and an edible oil  
or fat such as cocoa butter are well known. An  
important group of these food products is comprised of  
confections, including candy.

25           The most popular chocolate or chocolate candy  
consumed in the United States is in the form of sweet  
chocolate or milk chocolate. Milk chocolate is a  
confection which contains nonfat milk solids, milkfat,  
chocolate liquor, a nutritive carbohydrate sweetener,  
cocoa butter and may include other optional ingredients  
30 such as emulsifiers and flavorings and other additives.

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1 Sweet chocolate differs from milk chocolate in that it  
requires more chocolate liquor and limits the amount of  
milk solids. Semisweet chocolate requires at least 35%  
5 by weight chocolate liquor and is otherwise similar in  
definition to sweet chocolate. Commonly known dark  
chocolate, generally containing only chocolate liquor, a  
nutritive carbohydrate sweetener and cocoa butter, is by  
definition either a sweet chocolate or a semisweet  
chocolate. Buttermilk chocolate and skim milk chocolate  
10 differ from milk chocolate in that the milk fat comes  
from various forms of sweet cream buttermilk and skim  
milk, respectively, and in the case of skim milk, the  
total amount of milkfat is limited to less than the  
minimum for milk chocolate. Mixed dairy product  
15 chocolates differ from milk chocolate in that the milk  
solid includes any or all of the milk solids listed for  
milk chocolate, buttermilk chocolate or skim milk  
chocolate. White chocolate differs from milk chocolate  
in that it contains no non-fat cocoa solids. As used  
20 herein, the term "chocolate" denotes chocolate, baking  
chocolate, milk chocolate, sweet chocolate, semisweet  
chocolate, buttermilk chocolate, skim milk chocolate,  
mixed dairy product chocolate, white chocolate and non-  
standardized chocolates, unless specifically identified  
25 otherwise.

Chocolate used in foods in the United States is  
subject to a standard of identity established by the  
U.S. Food and Drug Administration (FDA) under the  
Federal Food, Drug and Cosmetic Act. The U.S.  
30 definitions and standards for the various types of  
chocolate are well established. Nonstandardized

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1 chocolates are those chocolates which have compositions  
which fall outside the specified ranges of the  
standardized chocolates.

Examples of nonstandardized chocolates result  
5 when the cocoa butter or milkfat are replaced partially  
or completely; or when the nutritive carbohydrate  
sweetener is replaced partially or completely; or  
flavors imitating milk, butter or chocolate are added or  
other additions or deletions in formula are made outside  
10 the USFDA standards of identify of chocolate or  
combinations thereof.

As a confection, chocolate can take the form of  
solid pieces of chocolate, such as bars or novelty  
shapes, and can also be incorporated as a component of  
15 other, more complex confections where chocolate is  
combined with and generally coats other foods such as  
caramel, nougat, fruit pieces, nuts, wafers or the like.  
These foods are characterized as microbiologically  
shelf-stable at 65-85°F under normal atmospheric  
20 conditions. Other complex confections result from  
surrounding with chocolate soft inclusions such as  
cordial cherries or peanut butter. Other complex  
confections result from coating ice cream or other  
frozen or refrigerated desserts with chocolate.  
25 Generally chocolate used to coat or surround foods must  
be more fluid than chocolates used for plain chocolate  
solid bars or novelty shapes.

The process of coating chocolate onto a food is  
known as enrobing. Enrobing is accomplished when the  
30 chocolate is in a fluid state and a proper viscosity

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1 must be maintained in order to produce a satisfactory  
coated product.

Chocolate can also be moulded. By moulding, it  
is meant that chocolate, either plain or mixed with  
5 nuts, raisins, crisped rice and the like is deposited in  
moulds, allowed to cool and hardened into solid pieces  
and then removed from the mould. Chocolate moulded into  
plain chocolate pieces generally can be somewhat more  
viscous than coating chocolates since the chocolate can  
10 be vibrated into a mould over a longer period of time  
than allowed in enrobing. However, chocolate moulded  
with food inclusions generally must be as fluid as  
coating chocolates.

Some novelty shapes made of plain chocolate are  
15 extruded onto a cold belt such as Kisses® or chocolate  
chips. Because the chocolate is extruded onto a cold  
belt, it must be more viscous than for moulded plain  
chocolate. Extruded chocolates are essentially extruded  
to a particular shape and require a yield value to  
20 retain the extruded shape while the chocolate hardens.

As noted above, the rheological characteristics,  
i.e., the flow properties, of chocolate are very  
important. Chocolate is non-Newtonian in nature. That  
is, it flows differently depending upon how the  
25 chocolate is stirred or pumped or how quickly it is  
poured. These characteristics are described by two  
measurements: a yield value, which relates to how much  
force one must use to start the chocolate flowing; and a  
plastic viscosity, which approximates the work done to  
30 keep the chocolate flowing uniformly. If either the  
yield value or the plastic viscosity is not within

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1 certain prescribed limits, poor processing will result.  
J. Chevalley, J. Texture Studies, 6: 177-196 "Rheology  
of Chocolate" (1975) reported typical Casson yield  
values and Casson plastic viscosities for commercial  
5 coating chocolates of 0-200 dyn/cm<sup>2</sup> and 5-25 poise,  
respectively, and for commercial moulding chocolates of  
100-2000 dyn/cm<sup>2</sup> and 10-200 poise, respectively. These  
values were confirmed some thirteen years later by J.  
Chevalley, Industrial Chocolate Manufacture and Use,  
10 Blackie & Son Ltd. Glasgow and London by AVI (1988).

The process of making chocolate is reviewed  
generally in B.L. Zoumas and E.J. Finnegan, "Chocolate  
and Cocoa", Kirk-Othmer Encyclopedia of Chemical  
Technology, Vol. 6 (3rd Ed., Wiley-Interscience, New  
York) 1-19 (1985). Processes for producing chocolate  
15 can be either "wet" or "dry". In the "wet" process,  
sweetened condensed milk is codried with chocolate  
liquor to generate a crumb that is microbiologically  
stable. In the "dry" process, milk powder is utilized  
20 rather than condensed milk. As such, the ingredients as  
received are microbiologically stable.

The "dry" process of making chocolate consists  
essentially of the steps of mixing, refining, conching  
or liquefying, standardizing and tempering to generate  
the desired rheology as needed for enrobing, moulding or  
25 producing novelty shapes.

In the first step in the preparation of milk  
chocolate, a nutritive carbohydrate sweetener such as  
extra fine grade granulated sucrose is combined and  
30 mixed with cocoa butter, chocolate liquor and spray  
dried whole milk powder. The resulting mixture is a



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1 paste. Next, in the refining step, essentially a fine  
grinding operation, the coarse paste from the mixer is  
passed between steel rollers and converted to a refined  
flake. Refining breaks up crystalline sugar, fibrous  
5 cocoa matter and milk solids such that the sizes of the  
particles are significantly reduced. This particle size  
reduction results in the desired smoothness of the  
chocolate. Fine chocolates usually have no particles  
larger than 20 or 25 microns. This is usually  
10 accomplished by passing the mixture through a plurality  
of refining rolls.

In the conching step, the mixture is then stirred  
while heating to give the final desired consistency to  
the milk chocolate. This mixing-kneading process allows  
15 moisture and volatile components to escape while  
smoothing the chocolate paste and is critical to the  
flavor and texture development of the chocolate.

Alternatively to the conching step, the  
liquefying step mixes refined flake under high shear  
20 over a short period of time. The refined flake is  
quickly converted to a suspension of solids in a  
continuous fat phase. The lack of flavor development  
can be corrected by pretreating the liquor and cocoa  
butter.

25 Additional fat and emulsifier are then added in  
the standardizing or finishing step to adjust viscosity  
to final specifications.

The final step in obtaining the desired rheology  
of the chocolate is tempering, a process of inducing  
30 satisfactory crystal nucleation of the liquid fat in the  
chocolate. If the chocolate is improperly cooled, the

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1 resulting chocolate will have a grainy texture as well  
as poor color and appearance.

Finished chocolate is a suspension of very fine  
particles (usually less than 50 microns) in fat. The  
5 particles usually consist of cocoa solids and  
crystalline sucrose as well as milk solids in the case  
of milk chocolate. The cocoa solids in the chocolate  
liquor and the milk solids have normally been processed  
so they are fine enough to be incorporated into a  
10 chocolate mixture. Sucrose, however, requires  
considerable size reduction since extra fine grade  
sucrose, for example, typically varies in crystal size  
from about 40 to 1000 microns. To satisfactorily  
function as an ingredient in chocolate, therefore, these  
15 sucrose crystals should be reduced in size to less than  
about 50 microns. Similar considerations apply in the  
processing of other types of confections. It is known  
that at least about 50% of the surface area of particles  
in milk chocolate is produced by the presence of  
20 particles below two microns in size. The presence of  
these ultrafine particles increases viscosity and  
increasing amounts of fat, e.g., cocoa butter, are  
required to coat such particles in order for the  
chocolate to flow properly in manufacturing operations.

25 Of particular concern in today's market is the  
fat content of a product. The amount of total fat in  
chocolates may vary somewhat depending on the  
formulation and process involved. In recent years, in  
view of this concern, there has been a steady reduction  
30 in the total fat contents of all chocolate. See B.  
Minifie, Chocolate, Cocoa, and Confectionery-Science and

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1 Technology, 3rd Edition, Van Nostrand Reinhold, New York  
(1989) p. 205. In fact, as Minifie reports, "good-  
quality finely ground chocolates with total fat contents  
down to 28% can now be produced and satisfactorily  
5 moulded. Lower quality chocolates with coarser particle  
size can be produced down to 25%. Particularly with  
milk chocolate, quality suffers with fat contents below  
30%, the texture becoming pasty with a lack of snap."

L.R. Cook, Chocolate Production and Use, Books  
10 for Industry, Inc., New York (1975) p. 214, reports that  
in order to maintain the proper rheological properties,  
chocolate requires a minimum amount of total fat from 29  
to 32% by weight. It was commonly believed by the  
skilled artisan that if the fat level was below said  
15 range, quality defects such as mealy, dry or powdery  
texture, and excessive coating permeability leading to  
dry centers would result. S.T. Beckett, PMCA Research  
Notes 16 (1):1-2 (April 1992) reported the production of  
cake chocolate with a fat content as low as 25% but  
20 acknowledged the same was extremely "thick".

It is thus well known in the art that the amount  
of fat present in chocolate will affect the flow  
properties of the chocolate, i.e., the addition of fat  
to a chocolate decreases both the yield value and the  
25 plastic viscosity. Consequently, fat content must  
therefore be varied according to the intended use. For  
example, proper fat content for moulding chocolate was  
reported at 30-34% and 35-40% for covering chocolate by  
Lees and Jackson, Sugar Confectionery and Chocolate  
30 Manufacture, Chemical Publishing Co., Inc., New York  
(1975) pg. 124.

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1        When the fat content of chocolate is reduced,  
other parameters must be affected in order to maintain  
the proper rheological properties of the chocolate. The  
presence of fat in chocolate is important in that the  
5 fat covers the surface of all the solid particles.  
Uncoated surfaces would cause rubbing between the  
particles and reduce the flow.

Chocolates contain a very large amount of small  
sugar particles. Fat does not cover the surface of the  
10 sugar particles very easily and consequently, anything  
which will form an interface between the sugar and fat  
will aid in the flow of the chocolate. Surfactants,  
e.g., emulsifiers, can produce such an interface by  
coating the surface of the solid particles, in  
15 particular, the sugar. As used herein, the term  
"surfactant" means any compound that reduces surface  
tension between a liquid and a solid in solution.

Emulsifiers or surfactants such as lecithin are  
extremely effective in improving the flow properties of  
chocolate, and are widely used for their commercial  
20 benefit as a partial cocoa butter replacer. It has been  
reported that the addition of 0.1-0.3% soya lecithin  
reduces the viscosity by more than 10 times its own  
weight of cocoa butter. Numerous other emulsifiers have  
25 been found to have similar effects as lecithin in  
lowering the yield value and plastic viscosity.  
Emulsifier use has generally been limited to less than  
1% of the chocolate formulation due to problems such as  
off-flavors, legal controls, or negative rheological  
30 effects at high levels. Since full-fat chocolates at  
29-33% total fat typically contain 0.1-0.5% soya

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1 lecithin, significantly lower fat levels cannot be  
achieved by altering the type/level of emulsifier.

Particle size of ingredients is also known to  
influence the viscosity of chocolate. As the particle  
5 size decreases, the viscosity increases as a general  
rule. An excess of fine particles below 5 microns  
whether derived from the sugar, milk, or chocolate  
liquor/powder component, will make the chocolate  
extremely thick and difficult to manage during pumping,  
10 depositing, and enrobing operations. Coarse particles  
will tend, however, to give the chocolate a gritty sandy  
texture which is unacceptable to consumers should the  
particle size exceed 60 microns.

Additionally, it is also well known within the  
15 chocolate industry that moisture content has a  
significant effect on the flow properties of chocolate.  
If water is added to chocolate, a marked increase in  
viscosity occurs. It has been previously reported that  
both the yield value and plastic viscosity increase with  
20 moisture levels above 1.1%. Between 0.6-1.1% moisture,  
the plastic viscosity is nearly constant whereas the  
yield value rises with increasing moisture. This could  
be explained by the formation of layers of syrup on the  
surface of sugar particles with an increase in moisture,  
25 which increases the friction between the said particles.

In order to produce a reduced fat chocolate with  
acceptable flow properties, it is essential to keep the  
moisture content low. Conching for extended periods of  
time (longer than 4 hrs.) at elevated temperatures  
30 (above 100°F) is well known to be an effective method  
for removing water from chocolate paste. The initial

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1 ingredients should be selected to have low moisture, and  
chocolate processing should be done so that moisture  
uptake from the atmosphere by hygroscopic ingredients is  
kept to a minimum.

5 A review of 37 different branded chocolates made  
by chocolate manufacturers in Europe, Asia or the  
Americas indicates a range of fat for predominantly milk  
chocolate from 27.5% to 45.1% by weight fat with an  
average fat content of 32.7% by weight. Additionally,  
10 three branded nonstandardized chocolates manufactured  
either in Europe or the U.S. were observed with 25.4-  
26.0% fat. Four branded European dietary chocolates,  
whereby a sugar alcohol such as mannitol or sorbitol  
substituted for a nutritive carbohydrate such as  
15 sucrose, were by analysis observed to contain from 37.9%  
to 45.0% fat. Further, analysis of the coating  
chocolate used in the first 25% less calorie composite  
bar marketed in the U.S. revealed a coating with 28% fat  
content. However, to date, despite efforts in the  
20 industry, no one has been able to produce a chocolate  
consisting of less than 25% total fat having flow  
properties suitable for moulding, extruding or enrobing  
operations.

The present invention relates to a lowfat  
25 chocolate of full-fat texture comprising a fat and  
nonfat solids comprising nutritive carbohydrate  
sweetener, and an edible emulsifier, said chocolate  
containing 20-24.5% fat.

Also, the present invention relates to an edible  
30 food product containing chocolate having the taste and  
texture attributes of a normal fat content with far less

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1 fat. Thus, the chocolate of the present invention is  
suitable for use in such products as confectioneries,  
(e.g., candy bars), baking chocolate, chocolate chips,  
ice cream bars, refrigerated desserts or other foods in  
5 which chocolate is an ingredient. In these foods, the  
chocolate has the rheological flow properties associated  
with normal fat content chocolate but with far less fat.  
The total fat content of chocolate compositions of the  
present invention is 20 to 24.5% by weight. The  
10 chocolate of the present invention contains non-fat  
solids which comprise nutritive carbohydrate sweeteners  
or sugar substitute, and an edible emulsifier.

The present invention further relates to methods  
of producing various types of chocolate, e.g.,  
15 confectionery items, with a reduced total fat content  
which still has taste, texture, and flow properties  
similar to normal full-fat confectionery products. In  
the preferred products of the present invention, the  
total fat content is as low as 20% wt. In the present  
20 process, nutritive carbohydrate sweetener is mixed with  
a fat or reduced calorie fat or combination thereof.  
The mixture is refined to reduce the particle size. A  
surfactant is added to the mixture in the presence of  
water, and the mixture is dried under agitation and  
25 heated until the desired consistency with the desired  
fat content is obtained.

In the accompanying drawings, Figure 1 represents  
a flow diagram of the modified process of refining the  
nutritive carbohydrate sweetener (e.g., saccharide)  
30 crystals of the present invention.

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1        Figures 2 and 3 illustrate variations on the  
process for making a lowfat chocolate in accordance with  
the present invention.

      Figures 4 and 5 illustrate variations on the  
5 process for making a low fat/low calorie chocolate in  
accordance with the present invention.

      The present invention relates to a chocolate or  
chocolate-like food product in which the fat content is  
20-24.5% by weight. The chocolate product contains a  
10 nutritive carbohydrate sweetener, a fat or reduced  
calorie fat or combination thereof and an edible  
emulsifier or surfactant.

      In an alternative embodiment of the present  
invention, a sugar substitute may partially replace the  
15 nutritive carbohydrate sweetener. As used herein, the  
term "sugar substitute" includes bulking agents, sugar  
alcohols (polyols), or high potency sweeteners or  
combinations thereof.

      The high potency sweeteners include aspartame,  
20 cyclamates, saccharin, acesulfame, neohesperidin  
dihydrochalcone, sucralose, alitame, stevia sweeteners,  
glycyrrhizin, thaumatin and the like and mixtures  
thereof. The preferred high potency sweeteners are  
aspartame, cyclamates, saccharin, and acesulfame-K.

25        Examples of sugar alcohols may be any of those  
typically used in the art and include sorbitol,  
mannitol, xylitol, maltitol, isomalt, lactitol and the  
like.

      Bulking agents as defined herein may be any of  
30 those typically used in the art and include

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1 polydextrose, cellulose and its derivatives,  
maltodextrin, gum arabic, and the like.

Fats, as used herein, refer to triglycerides,  
diglycerides and monoglycerides that can normally be  
5 used in chocolates. Fats include the naturally  
occurring fats and oils such as cocoa butter, pressed  
cocoa butter, expeller cocoa butter, solvent extracted  
cocoa butter, refined cocoa butter and the like..

Reduced calorie fat, as used herein, is a fat  
10 having all the properties of typical fat but exhibiting  
less calories than typical fat. An example of a reduced  
calorie fat is Caprenin as described in U.S. Patent No.  
4,888,196 to Ehrman, et al., which is incorporated  
herein by reference.

15 The chocolate or chocolate type products of the  
present invention contain emulsifiers. Examples of safe  
and suitable emulsifiers may be any of those typically  
used in the art and include lecithin derived from  
vegetable sources such as soybean, safflower, corn,  
20 etc., fractionated lecithins enriched in either  
phosphatidyl choline or phosphatidyl ethanolamine or  
both, mono- and diglycerides, diacetyl tartaric acid  
esters of mono- and diglycerides, monosodium phosphate  
derivatives of mono- and diglycerides of edible fats or  
25 oils, sorbitan monostearate, polyoxyethylene sorbitan  
monostearate, hydroxylated lecithin, lactylated fatty  
acid esters of glycerol and propylene glycol,  
polyglycerol esters of fatty acids, propylene glycol  
mono- and diester of fats and fatty acids or any  
30 emulsifier that may become approved for the USFDA-  
defined soft candy category. In addition, other

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1 emulsifiers that can be used in the present invention,  
include polyglycerol polyricinoleate, ammonium salts of  
phosphatidic acid, sucrose esters, oat extract, etc.,  
any emulsifier found to be suitable in chocolate or  
5 similar fat/solid system or any blend provided the total  
amount of emulsifier does not exceed 1% by weight.  
Emulsifiers preferred for use in the present invention  
are lecithin, fractionated lecithin, diacetyl tartaric  
acid esters of mono- and diglycerides (DATEM) or  
10 mixtures of these emulsifiers at a maximum level of 1%  
of any one emulsifier or any mixture of emulsifiers.

Nutritive carbohydrate sweeteners with varying  
degrees of sweetness intensity useful in the present  
invention may be any of those typically used in the art  
and include, but are not limited to, sucrose, (e.g.,  
15 from cane or beet), dextrose, fructose, lactose,  
maltose, glucose syrup solids, corn syrup solids, invert  
sugar, hydrolyzed lactose, honey, maple sugar, brown  
sugar, molasses and the like. The nutritive  
20 carbohydrate sweetener, preferably sucrose, will be  
present in the chocolate as crystals or particles.

As indicated hereinabove, the particle size of  
the ingredients, especially the sweetener, can influence  
the viscosity of the chocolate. Particle sizes can be  
25 measured by various techniques known to those skilled in  
the art. These techniques include the Malvern® laser  
light scattering technique, measurement using a  
micrometer and measurement using a microscope and the  
like. Unless otherwise specified herein, when referring  
30 to the particle size of the nutritive carbohydrate  
sweetener, the measurements were taken using the

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1 Malvern laser light scattering technique. Furthermore,  
unless otherwise specified herein, when referring to the  
particle size of the finished chocolate, the  
measurements were taken using a micrometer. In a  
5 preferred embodiment, the particle size of the nutritive  
carbohydrate sweetener and the nonfat cocoa solids are  
within a certain specified range in order to maintain  
specified rheological properties.

In an embodiment of the present invention, the  
10 size of the particles of the nutritive carbohydrate  
sweetener are substantially all between 1 to 60 microns.  
In a preferred embodiment, substantially all of the  
particles are between about 3-50 microns in size. In an  
even more preferred embodiment, substantially all of the  
15 particles are between about 5-40 microns in size. Less  
than 5% of the particles would be below the lower limit  
and less than 2% of the particles would be above the  
upper limit on a weight basis.

Maintaining substantially all of the nutritive  
20 carbohydrate sweetener particles greater than 1 micron  
allows use of minimum amounts of fat to develop the  
taste, texture and flow properties similar to a full-fat  
product. Particle sizes above 60 microns cause  
graininess.

25 In a preferred embodiment of the present  
invention, the chocolate or chocolate food product has  
22-24.5% by weight of total fat or reduced calorie fat

As used herein, unless otherwise specified, all  
percentages are calculated on a weight basis of  
30 ingredient to chocolate. For example, if an ingredient

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1 is present in 10%, it is meant that there are 10 g of  
that ingredient in 100 g of chocolate.

The chocolates of the present invention may  
contain a trace of water. It is preferred that they  
5 contain less than 1% moisture, preferably less than  
0.75% by weight, in order to meet the flow requirements.  
Higher moisture is very detrimental to the Casson yield  
value and plastic viscosity and would otherwise require  
substantial additional fat to counteract its negative  
10 effect on rheology.

The chocolates of the present invention may  
additionally contain optional ingredients. These  
optional ingredients include nonfat milk solids, nonfat  
cocoa solids, sugar substitutes, natural and artificial  
15 flavors (e.g., vanillin, spices, coffee, ethyl vanillin,  
salt, brown nut-meats, natural vanilla, etc., as well as  
mixtures of these), antioxidants (e.g., preservatives  
such as TBHQ, tocopherols and the like), proteins, and  
the like.

20 In a preferred embodiment, the chocolate contains  
substantially all particles having a size of less than  
45 microns as measured by a micrometer for coatings and  
less than 40 microns for solid bars and novelty shapes.

The preparation of a lowfat chocolate or a  
25 lowfat/reduced calorie chocolate having a fat content as  
low as 20% is prepared by the process described herein.  
In this process, the trick was to find a means of  
reducing the fat content while maintaining the  
rheological properties suitable for enrobing, moulding  
30 or extruding. The present inventors have developed such  
a process.

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1       The process described herein is a general process  
for preparing these lowfat and lowfat/reduced calorie  
chocolates. However, the preferred products prepared by  
this process are the lowfat chocolates or the  
5 lowfat/reduced calorie chocolates defined herein wherein  
the fat content or the reduced calorie fat content,  
where applicable, is in the range from 20 to 24.5%, and  
more preferably from 22.0-24.5%.

As was described above, fat in chocolate, for  
10 rheological and organoleptic purposes is needed to coat  
all the surfaces of the solid and to fill the voids  
between these solids. If the total surface area and  
porosity of the solids is reduced, the fat requirements  
will be reduced. The total surface area and porosity  
15 can be reduced by two methods: either by reducing the  
surface area of the nutritive carbohydrate sweetener by  
a water addition and recrystallization operation, or by  
densifying some or all of the solids.

In U.S. Patent No. 5,080,923 (Martin), granulated  
20 nutritive carbohydrate sweetener is first reduced in  
particle size to the finished product specification by  
various methods including milling and roll refining.  
Either before or after size reduction, the nutritive  
carbohydrate sweetener is blended with fat, i.e., cocoa  
25 butter. At this point water is blended into the  
mixture. The water dissolves the ultrafines (particles  
below 10 microns) and dissolves the angular and jagged  
edges of the larger particles. The mixture is dried.  
During drying, the nutritive carbohydrate sweetener in  
30 solution recrystallizes on the larger nutritive  
carbohydrate sweetener crystals which further rounds and

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1 smooths the particles. As a result of this procedure,  
an overall reduction of as much as 50% in surface area  
can be achieved. However, during the drying process,  
the nutritive carbohydrate sweetener has a tendency to  
5 agglomerate into particle sizes above the finished  
particle specification. To disperse these particles and  
achieve a smooth creamy texture in the finished  
chocolate, an additional size reduction step is  
required. Unfortunately, the additional step will not  
10 only disperse the agglomerates but may also crush  
individual particles and significantly increase the  
total surface area by introducing new ultrafines and  
angular and jagged surfaces. This additional surface  
area limits the fat savings potential of the technology  
15 and chocolates so that chocolates with only 27% fat can  
be obtained. However, the present invention overcomes  
the limitations inherent in Martin and brings the total  
fat content below 25%.

The improved process of refining nutritive  
20 carbohydrate sweetener crystals of the present invention  
eliminates the problem of agglomeration and the second  
size reduction step of Martin through the use of  
surfactants or emulsifiers. As in Martin, fat and  
nutritive carbohydrate sweetener are mixed and then  
25 passed through a particle size reduction process,  
typically roll refining or nutritive carbohydrate  
sweetener milling as shown in Figure 1. In the roll  
refining process, the fat or reduced calorie fat or  
combination thereof and nutritive carbohydrate sweetener  
30 are mixed in batch mixer 2 to form a mixture 4 which is  
then passed through the nip of at least one pair of roll

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1 refiners (6, 8) to produce a mixture 10 having particles  
smaller than about 50 microns. Water, in the amount of  
1 to 10% by weight of the nutritive carbohydrate  
sweetener, is added to the mixture 10 for the purpose of  
5 dissolving fines and rounding larger crystals.

Alternatively, the mixture 10 can be prepared by  
first refining the nutritive carbohydrate sweetener in a  
mill 18 and then blending the nutritive carbohydrate  
sweetener with the fat or reduced calorie fat or  
10 combination thereof in a blender 30 in accordance with  
procedures known to one skilled in the art.

In the prior process, when the mixture 10 is  
dried, agglomeration occurs. It has been discovered by  
the present inventors that adding a surfactant to the  
15 mixture 10 before drying prevents agglomeration.  
Accordingly, the addition of surfactants, e.g.,  
lecithin, preferably in amounts less than 1% by weight,  
in the presence of small amounts of water, preferably 1-  
5% by weight, along with agitation throughout the drying  
20 process will prevent agglomeration. For the drying  
step, both batch and continuous driers yield a flowable,  
non-agglomerated paste. For batch drying, typical  
chocolate conches 12 yield good results. Typical drying  
times are from about 60 to about 120 minutes at  
25 temperatures of about 120 to about 160°F. For  
continuous drying, paddle driers 14 have proven  
successful. Typical drying times for paddle dryers are  
approximately 40 to about 120 minutes at temperatures of  
about 120 to about 180°F for acceptable results. Both  
30 drying processes result in a nutritive carbohydrate  
sweetener/fat paste 16 which is agglomerate free,

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1 flowable and has low viscosity. Preferably, in  
accordance with the present invention, the drying  
produces a product having 10-24% of fat (w/w) in the  
nutritive carbohydrate sweetener/fat paste. The  
5 moisture content is preferably less than 0.2% wt.  
No secondary size reduction step is necessary. This  
paste is then added to the other ingredients which have  
been reduced to finished particle size specification.  
This final mixture is conched and standardized to the  
10 specified fat level.

The process of the present invention also allows  
for flexibility in design. The desired reduction of the  
surface area of the nutritive carbohydrate sweetener can  
be accomplished with other confectionery ingredients  
15 present during the water/surfactant addition. These  
ingredients include chocolate liquor, cocoa powder, and  
milkfat.

Another method of reducing the surface area of  
the particle size of the sugar is by controlling the  
20 crystallization of a supersaturated solution of sugar  
while drying the sucrose syrup.

An additional method calls for the size reduction  
of sugar by any number of accepted milling techniques.  
A Micropul ACM mill will reduce the particle size of  
25 sugar within the desired range with a reduction of  
ultrafines and total surface area as compared to typical  
roll refining. Once the sweetener size has been  
reduced, the total surface area can be further reduced  
by physically removing particles below a specified size.  
30 Air classification can successfully separate smaller  
particles by taking advantage of the weight difference

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1 between the lighter small particles and the heavier  
larger particles. Other methods, such as screening, are  
also possible in removing the ultrafines from the size-  
reduced nutritive carbohydrate sweetener.

5 Aside from preparing the particle size of the  
nutritive carbohydrate sweetener, another method of  
reducing surface area is to densify any or all of the  
ingredients. In particular, dried milk solids can be  
greatly densified. Typically, spray dried whole milk  
10 powder (WMP) and spray dried non-fat milk solids (NFMS)  
are used in chocolate. Low density, highly porous  
sponge-like particles are created by the spray drying  
process. The density of the powder can be increased to  
a particularly dense state by either altering the spray  
15 drying process or by further processing of the dried  
product.

In a preferred embodiment, the nonfat milk solids  
are pretreated to compact the structure and crystallize  
a substantial portion of the lactose present in the milk  
20 solids. The bulk density (packed) should preferably  
exceed 0.7 g/ml and the degree of lactose conversion  
from the amorphous to crystalline state shall preferably  
exceed 30%, more preferably above 70%. Thus, nonfat dry  
milk powder can be prepared one of three ways to satisfy  
25 the preferred embodiment.

By introducing a lactose crystallization step  
before spray drying, the density of the dried powder is  
greatly increased. By precrystallizing the lactose, it  
enters the spray drier in a dense alpha monohydrated  
30 crystalline state and does not "puff-up" in a porous

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1 amorphous state. With lactose making up over 50% of  
NFMS, the overall density of the NFMS is increased.

For normal spray dried powder, the density can be  
increased by rewetting the powder and drying under  
5 pressure. The NFMS is dispersed into water (15 to 30%  
added water by weight relative to the NFMS) and dried  
under pressure either in a melange or through roll  
refiners. A secondary drying step is necessary to bring  
the final moisture to below 3%. During this process,  
10 the amorphous lactose is dissolved and dried in a  
crystalline state. The other solids are also  
pressurized and dried into a more collapsed, less porous  
state.

In a further method, the nonfat spray dried milk  
15 powder can also be compacted with sufficient heat and  
water in a twin screw extruder to collapse the protein  
structure and crystallize the amorphous lactose.

Apart from reducing the need for fat in  
confectionery items, another method to reduce fat is to  
20 make the fat which is present more functional. Much of  
the fat in typical chocolate products may be bound in  
some way and consequently are not available for  
lubrication. In WMP, as much as 90% of the milkfat may  
be trapped within the dried spheres. In chocolate  
25 liquor, some of the fat may be bound within the cellular  
structure. The present invention includes processes  
which will free the bound fat and allow it to be used  
for lubrication, consequently reducing the need for  
additional fat which would be required for the same  
30 purpose.

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1 In the case of WMP, the fat can become functional  
by a number of methods. NFMS with anhydrous milkfat  
(AMF) may be used to replace WMP. In this case nearly  
100% of the milkfat becomes functional. Also, the WMP  
5 can receive post-processing to free the fat. The method  
of rewetting and drying under pressure as described  
above will free the fat from the spray dried particles.  
As the lactose dissolves and the structure breaks down,  
the milkfat is freed and becomes functional. The fat  
10 can also be released by blending 2 to 10% moisture with  
the WMP and processing through a high shear twin screw  
mixer. In this process, the WMP particle is softened by  
the water and the shear which allows the fat to escape.

When producing a non-standard chocolate product,  
15 bound fat in liquor may be made available by pressing  
the liquor to a low fat level, e.g., 8 to 12% by weight.  
The pressing of the liquor will rupture the cellular  
structure of the cocoa solids allowing cocoa butter to  
escape. This process reduces the fat in the cocoa  
20 solids and allows a total reduction in fat in the  
finished product without a loss in product quality or an  
increase in viscosity. A further reduction may be  
achieved by extracting the fat with solvents. In this  
case, the fat content of the cocoa powder will be well  
25 below 8% by weight and a greater fat reduction may be  
achieved.

Each of the above methods make it possible to  
reduce the fat content of chocolate products without  
increasing the viscosity or lowering the textural  
30 quality. In order to lower the fat content to below 25%  
and as low as 20% by wt., normally, these methods must

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1 be used in some combination. For milk and white  
chocolate, low fat levels can be achieved by using the  
improved process of refining the saccharide crystals and  
a combination of NFMS and AMF to replace the WMP. For  
5 dark and semi-sweet chocolates, the modified process of  
refining the saccharide crystals is needed for low fat  
production.

Figure 2 generally illustrates a process for  
preparing a lowfat chocolate in accordance with the  
10 present invention. Fat (e.g., cocoa butter) and  
nutritive carbohydrate sweetener or non-sugar sweetener  
are mixed in a batch mixer 2. As used herein, the non-  
sugar sweetener refers to a high potency sweetener or  
polyol or combination thereof. The mixture is  
15 subsequently refined by being passed through the nips of  
a plurality of roll refiners (6, 8) to produce a mixture  
10 containing sweetener/fat particles (nutritive  
carbohydrate sweetener, non-sugar sweetener or  
combination thereof/fat particles), preferably smaller  
20 than about 60 microns. In this particular embodiment of  
the process of the present invention, water and  
surfactant are added to the sweetener/fat mixture and  
subjected to the drying process e.g., in a paddle dryer  
14 (or in a conch) to obtain an 18 to 24% fat by weight  
25 sweetener/fat paste 16 with a moisture content of less  
than 0.2% wt. and which can be placed in storage 20.

Apart from the preparation of the sweetener/fat  
paste described above, the other chocolate-making  
ingredients may be prepared separately. Said additional  
30 ingredients include, but are but not limited to, nonfat  
milk solids, cocoa powder, chocolate liquor, lactose,

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1 milkfat, whole milk powder or mixtures thereof. With  
respect to Figure 2, chocolate liquor, nonfat milk  
solids and anhydrous milkfat, and cocoa butter are mixed  
in a batch mixer 2' and subsequently refined by being  
5 passed through the nips of a plurality of roll refiners  
(6', 8') to produce a mixture 22 having particles  
preferably smaller than about 50 microns.

The sweetener/fat paste 16 can then be mixed with  
the mixture 22 in a conch 24 while heating to give the  
10 final desired consistency to the chocolate. Additional  
fat and emulsifiers, e.g., lecithin, anhydrous milkfat  
and cocoa butter, are then added in the standardizing  
step, as shown in Figure 2, to adjust the viscosity of  
the chocolate to final specifications and to produce a  
15 20-24.5% fat chocolate.

Figure 3 illustrates a variation on the version  
of the process shown in Figure 2. In the process shown  
in Figure 3, after refinement, in accordance with the  
procedure described above and outlined in Figure 2, the  
20 sweetener/fat mixture 10 is immediately subjected to a  
batch drying process in a conch 24. No paddle drying is  
used in this methodology, as in Figure 2. The remainder  
of the process is similar to that of Figure 2. More  
specifically, the other ingredients, e.g., liquor, NFMS,  
25 AMF, and cocoa butter are added, conched and  
standardized as in Figure 2.

Figure 4 illustrates a further variation on the  
process of the present invention. Figure 4 relates to  
the process of making a low fat/low caloric chocolate.  
30 A reduced calorie fat, such as Caprenin, is mixed with a  
sweetener comprising a non-nutritive sweetener and a

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1 nutritive sweetener and refined in accordance with the  
procedure described in the text hereinabove with regard  
to Figure 2. This sweetener/lowfat mixture 10' is then  
dried by the techniques as described in relation to  
5 Figure 2. For example, a paddle drier or a conch 12,  
such as illustrated in Figure 4 can be used to produce a  
sweetener/lowfat paste 16' with a moisture content of  
less than 0.2% wt., and which can optionally be placed  
in storage.

10 The other lowfat/low calorie making ingredients,  
e.g., NFMS, liquor, bulking agents (such as polydextrose  
and the like), cocoa powder, flavors and low calorie  
fat, are prepared separately, as described above to  
produce a mixture 22' having particles preferably  
15 smaller than about 50 microns. The mixture 22' can then  
be mixed in a conch 24 while heating to give the final  
desired consistency to the chocolate. Additional fat,  
reduced calorie fat and surfactant are then added in  
the standardizing step, e.g., lecithin, AMF, cocoa  
20 butter and additional reduced calorie fat, to adjust the  
viscosity of the chocolate to final specifications and  
to produce a 20-24.5% fat reduced calorie chocolate.

Figure 5 shows yet another variation of the  
process of the present invention and illustrates the  
25 process of making a low fat/reduced calorie chocolate  
analogous to the process illustrated in Figure 3, except  
that reduced calorie ingredients, e.g., low calorie  
fats, and bulking agents are used instead of fat.

The chocolates of the present invention can be  
30 used in a solid bar in which the entire bar is made up  
of solely chocolate. The solid bar is preferably a

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1 geometrical shape, for example, a circle, a rectangle or  
a square.

The chocolates of the present invention can additionally be used as a coating. As used herein, the  
5 term "coating" refers to a food which is covered or enveloped with a chocolate. Various foods which may be coated include fruits (e.g. cherries, strawberries, bananas and the like), marshmallow, cake, cookies, toffee, peanut butter, caramel, nuts, raisins, nougat,  
10 baked goods, ice cream bars, candy bars, puddings, creams and the like. Consequently, as used herein, a solid bar with inclusions is a type of coating.

Apart from being used in a solid bar and as a coating, the chocolates of the present invention can  
15 also be used in making novelty shapes as previously defined.

The preferred chocolate made according to the process of the present invention, which has desirable flow properties, contain 20 to 24.5% wt. total fat, preferably 22 to 24.5%. In addition, it preferably  
20 contains less than 7% milkfat, less than 1% moisture, preferably below 0.75 % wt., and 35% minimum, preferably over 40%, nutritive carbohydrate sweetener with specific limitations on the sweetener particle size. Because of  
25 this unique composition, the chocolate of the present invention meets flow requirements for both moulding or enrobing. The values are presented in Table 1. It is noted that a different relationship than suggested by Chevalley (1970) of yield value and viscosity was  
30 observed due to the ability of the present invention to generate chocolate with uniquely low yield values.

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1 These uniquely low yield values allow chocolates with  
 higher viscosities than suggested by Chevalley to  
 function as coating chocolates in a production setting.

5 **TABLE 1. RHEOLOGICAL VALUES**

		<u>PREFERRED</u>	<u>MOST PREFERRED</u>
	A. For Solid Bars		
	-Casson Yield Value (dyn/cm <sup>2</sup> )	< 200	< 100
	-Casson Plastic Viscosity (poise)	< 200	< 150
10	-Micrometer particle size of chocolate	< 40	< 30
	B. For Coatings or solid bars with inclusions (enrobing, shell moulding)		
	-Casson Yield Value (dyn/cm <sup>2</sup> )	< 80	< 35
	-Casson Plastic Viscosity (poise)	< 80	< 170
15	Sum of Casson yield Value and Casson Plastic Viscosity	< 160	< 205
	-Micrometer particle size of chocolate	< 45	< 45
	C. For Novelty Shapes-Extruded Chocolates (example-Kisses ®)		
20	-Casson Yield Value (dyn/cm <sup>2</sup> )	< 2000	< 300
	-Casson Plastic Viscosity (poise)	< 200	< 200
	-Micrometer particle size of chocolate	< 40	< 30

Milk chocolate must also, in addition to the  
 requirements already given for the total fat, milkfat,  
 moisture, rheology, and nutritive carbohydrate  
 25 sweetener, contain a minimum of 8.61% milk solids-nonfat  
 and 10% chocolate liquor, a range of 3.39-7.00% milkfat  
 and maximum 1% safe and suitable emulsifier. The more  
 preferred levels are 12-20% milk solids-nonfat, 3.39-  
 30 5.00% milkfat, 12-15% chocolate liquor, and 0.5% maximum  
 emulsifier. Cocoa butter may be added as needed to

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1 reach the desired total fat content. The proportion of  
milkfat to cocoa butter is important so that the desired  
degree of hardness is achieved in the chocolate. The  
milkfat component can be delivered by anhydrous milkfat  
5 (AMF), cream, butter, whole milk powder, nonfat milk  
powder or any mixture thereof.

A skim milk chocolate can be formulated by  
keeping the milkfat component under 3.39%, preferably  
under 1%, and raising the minimum milk solids nonfat  
10 component to 12%. A buttermilk chocolate is similar to  
skim milk chocolate except that dried sweet cream  
buttermilk serves as the milk solids nonfat component.

Mixed dairy product chocolates are similar to  
milk chocolate except the milkfat component may be below  
15 3.39%. It is preferred that the milkfat component is 0  
to 7%, and more preferably 0 to 5.5%. Mixed dairy  
product chocolates allow a wider choice as to the type  
of milk solids nonfat component.

Sweet chocolates are similar to milk chocolates  
20 except the chocolate liquor content is usually 15-35%  
and the total milk solids may not exceed 12%. For this  
invention the milkfat component preferably ranges from 0  
to 7%, and more preferably from 0 to 3.5%. Semi-sweet  
chocolate (or bittersweet chocolate) is similar to sweet  
25 chocolate except the chocolate liquor content exceeds  
35%.

A white chocolate of this invention conforming to  
the proposed standard of identity granted to Hershey  
Foods Corporation under a temporary marketing permit (56  
30 Fed. Reg. 46798, September 16, 1991) would preferably  
contain 23.5-24.5% total fat consisting of 3.5-4.5%

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1 milkfat and 20.0-21.0% cocoa butter, 35-55% nutritive  
carbohydrate sweetener, preferably 40-55%, 10.5% minimum  
milk solids nonfat, preferably 12-25%, and less than  
0.5% chocolate liquor, preferably 0%.

5 Nonstandardized chocolates may contain sugar  
substitutes. Vegetable fats other than cocoa butter may  
replace some or all of the chocolate liquor to prepare a  
chocolate flavored confectionery such as compound  
coatings or imitation chocolate bars. Nonstandardized  
10 chocolates may also contain cocoa powders as partial or  
total substitutes for chocolate liquor. In a preferred  
embodiment, coarsely ground cocoa powder replaces over  
50% of the total cocoa solids and is prepared by  
grinding or pulverizing a cocoa presscake so that less  
15 than 75% will pass through a U.S. standard screen #200  
and less than 50% through a #400 screen. (Commercially  
available cocoa powders typically are ground in high  
impact mills such that 98%+ pass through a #200 screen  
and 90%+ through a #400 screen.) This coarsely ground  
20 cocoa powder can be fed into the nip of a roll refiner  
and final particle size reduction is accomplished by the  
rolls. This prevents the formation of an excessive  
amount of fine particles below 5 microns and thereby  
limits surface area which would otherwise require one to  
25 add more total fat in the chocolate for proper flow.

Chocolate with only 20-24.5% total fat is an  
excellent starting point for developing reduced calorie  
nonstandardized chocolates. A product with reduced  
calories can readily be obtained by utilizing a reduced  
30 calorie fat (such as Caprenin and the like), a sugar  
substitute or combinations thereof.

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1        When the sugar substitute partially replaces the  
nutritive carbohydrate sweetener or when the reduced  
calorie fat partially or totally replaces the fat, or  
combination thereof, the resulting chocolate is a low  
5 fat reduced calorie chocolate. The low fat reduced  
calorie chocolate is a type of low fat chocolate as  
defined herein. This chocolate contains the same  
ingredients as the low fat chocolate as described  
hereinabove, with the noted exceptions. Thus, this low  
10 fat reduced calorie chocolate also contains an edible  
emulsifier and optionally nonfat cocoa solids. It may  
also contain trace amounts of water. Further it may  
contain the other ingredients found in the various types  
of chocolate described hereinabove, e.g. milk chocolate,  
15 skim milk chocolate, buttermilk chocolate, mixed dairy  
product chocolate, sweet chocolate, semisweet chocolate,  
bittersweet chocolate, white chocolate, and non-  
standardized chocolate, with the above exceptions.  
Further, this reduced calorie low fat chocolate contains  
20 the rheological characteristics of the low fat chocolate  
described herein.

Tables 2A through 2G present various formulations  
of different standardized chocolates made in accordance  
with the present invention.

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1 **TABLE 2A. STANDARDIZED MILK CHOCOLATE COMPOSITIONS  
MADE IN ACCORDANCE WITH THE PRESENT INVENTION**

COMPOSITION		
Ingredients	Amount (% wt.)	
	Broad	Preferred
Total Fat	20-24.5	22-24.5
<sup>1</sup> Sweetener: Nutritive Carbohydrate Sweetener	>35	
Sucrose		>40
Milk Solids (nonfat): NFMS, WMP or any mixture	≥8.61	
NFMS <sup>2</sup>		12-20
Milkfat: Milkfat, cream, butter or from WMP	>3.39	
Anhydrous milkfat (AMF)		3.39-5.50
Cocoa Solids: Chocolate liquor	≥10	12-15
Emulsifier: Any safe and suitable emulsifier	≤1.0	
Lecithin or DATEM or any combination thereof		<1.0
Moisture Content	≤1.0	<0.75

25 <sup>1</sup> Have been pretreated to meet the particle size requirement (substantially all between 1-60 microns, 3-50 microns preferred, and 5-40 microns most preferred; less than 5% of sweetener below lower limit and 2% above upper limit on a weight basis) by: (1) a refining and wetting process as described in U.S. Patent No. 5,080,923 and improved herein to eliminate sugar fines; (2) a boiled sugar crystallization technique, or (3) grinding followed by size classification to remove both coarse sugar  
30 crystals and fine sugar particles.

<sup>2</sup> With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

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TABLE 2B. STANDARDIZED SKIM MILK CHOCOLATE COMPOSITIONS  
MADE IN ACCORDANCE WITH THE PRESENT INVENTION

5	COMPOSITION (same as standardized milk chocolate except for:)		
	Ingredients	Amount (% wt.)	
		Broad	Preferred
	Total Fat	20-24.5	22-24.5
	Milk Solids (nonfat): NFMS	≥12	
10	NFMS <sup>2</sup>		12-20
	Milkfat: Milkfat, cream, butter or from NFMS	≤3.39	
	Only from NFMS		<1

<sup>2</sup> With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

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1                   **TABLE 2C. STANDARDIZED BUTTERMILK**  
**CHOCOLATE COMPOSITIONS MADE IN ACCORDANCE WITH**  
**THE PRESENT INVENTION**

5	COMPOSITION (same as standardized milk chocolate except for:)		
	Ingredients	Amount (% wt.)	
		Broad	Preferred
	Total Fat	20-24.5	22-24.5
10	<b>Milk Solids (nonfat):</b> Dried sweet cream buttermilk	≥12	
	Dried sweet cream buttermilk <sup>2</sup>		12-20
	<b>Milkfat:</b> Milkfat, cream, butter or from dried sweet cream buttermilk	≤3.39	
15	Only from dried sweet cream buttermilk		<1

<sup>2</sup> With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

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1           **TABLE 2D.   STANDARDIZED MIXED DAIRY PRODUCT**  
             **CHOCOLATE COMPOSITIONS MADE IN ACCORDANCE WITH**  
             **THE PRESENT INVENTION**

5	<b>COMPOSITION</b> (same as standardized milk chocolate except for:)		
	<b>Ingredients</b>	<b>Amount (% wt.)</b>	
		<b>Broad</b>	<b>Preferred</b>
	<b>Total Fat</b>	20-24.5	22-24.5
10	<b>Milk Solids (nonfat):</b> NFMS, WMP, dried sweet cream buttermilk or any mixture	≥12	
	NFMS <sup>2</sup>		12-20
	<b>Milkfat:</b> Milkfat, cream, butter or from WMP, NFMS or dried buttermilk	0-24.5	
15	AMF		0-5.5

<sup>2</sup> With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

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1                   **TABLE 2E.   STANDARDIZED SWEET CHOCOLATE**  
                    **COMPOSITIONS MADE IN ACCORDANCE WITH**  
                    **THE PRESENT INVENTION**

5	<b>COMPOSITION</b> (same as standardized milk chocolate except for:)		
	<b>Ingredients</b>	<b>Amount (% wt.)</b>	
		<b>Broad</b>	<b>Preferred</b>
	<b>Total Fat</b>	20-24.5	22-24.5
10	<b>Milk Solids (nonfat):</b> NFMS, WMP, dried buttermilk or any mixture	≤12	
	NFMS <sup>2</sup>		0-12
	<b>Milkfat</b>	0-12.0	0-3.5
15	<b>Cocoa Solids:</b> Chocolate Liquor	15-35	15-35

<sup>2</sup> With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

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1      **TABLE 2F. STANDARDIZED SEMISWEET (BITTERSWEET)  
CHOCOLATE COMPOSITIONS MADE IN ACCORDANCE WITH  
THE PRESENT INVENTION**

5	<b>COMPOSITION</b> (same as standardized milk chocolate except for:)		
	<b>Ingredients</b>	<b>Amount (% wt.)</b>	
		<b>Broad</b>	<b>Preferred</b>
	<b>Total Fat</b>	20-24.5	22-24.5
10	<b>Milk Solids (nonfat):</b> NFMS, WMP, dried buttermilk or any mixture	≤12	
	<b>NFMS<sup>2</sup></b>		0-12
	<b>Milkfat</b>	0-12.0	0-3.5
15	<b>Cocoa Solids:</b> Chocolate Liquor	≥35	35-45

<sup>2</sup> With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

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1                    **TABLE 2G. STANDARDIZED WHITE CHOCOLATE<sup>3</sup>**  
                      **COMPOSITIONS MADE IN ACCORDANCE WITH**  
                      **THE PRESENT INVENTION**

5	<b>COMPOSITION</b> (same as standardized milk chocolate except for:)		
	<b>Ingredients</b>	<b>Amount (% wt.)</b>	
		<b>Broad</b>	<b>Preferred</b>
	<b>Total Fat</b>	23.5-24.5	23.5-24.5
10	<b>Sweetener-nutritive carbohydrate sweetener</b>	35-55	40-55
	<b>Milk Solids (nonfat)</b>	≥10.5	10.5-20
	<b>Milkfat</b>	3.5-4.5	3.5-4.5
	<b>Cocoa Solids: Cocoa Butter<sup>4</sup></b>	20.0-21.0	20.0-21.0

15                    <sup>3</sup> Based on temporary marketing permit to Hershey Foods  
Corp. published in 56 Fed. Reg. 46798, September 16, 1991.

<sup>4</sup> Cocoa powder and chocolate liquor must be absent, i.e.,  
less than 0.5% wt., preferably 0%.

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1       The chocolates prepared in the present invention  
can be used in edible food compositions such as  
confectioneries, chocolate chips, baking chocolate,  
chocolate covered fruits, chocolate covered baked goods,  
5 chocolate covered puddings, and the like. The chocolate  
of this invention can be used in a direct one to one  
substitution in edible food formulations wherever  
traditional chocolates are utilized.

10       The following examples are provided to further  
illustrate the present invention. In the following  
examples, rheology values of Casson plastic viscosity  
and Casson yield value were determined on a cone and  
plate system using a CarriMed/Mitech CS Rheometer. The  
cone is defined as: truncation of 101 $\mu$ m, stress factor  
15 of 0.0597, rate factor of 14.4, diameter of 4 cm and  
cone angle of 3 degrees and 58 minutes used with a  
measurement system inertia of 63.6 dyn cm sec<sup>2</sup>. The  
following conditions were used during measurement of the  
following chocolate examples: preshear stress of 0  
20 dyn/cm<sup>2</sup>, preshear time of 0 min and equilibration time  
of 1 min. The experiment mode of shear stress sweep was  
done at 40°C starting at 0 dyn/cm<sup>2</sup> and ending at 2500  
dyn/cm<sup>2</sup> (value of 2500 dyn/cm<sup>2</sup> used for Example 5) with a  
linear stress mode. (The ending shear stress was varied  
25 depending on the chocolate to give about a 9 sec<sup>-1</sup> shear  
rate response of the chocolate.) Ascent time was 8 min  
with no hold time at maximum shear stress followed by an  
8 min descent time. Casson plastic viscosity and Casson  
yield value were calculated from the shear stress/shear  
30 rate data using CarriMed software written according to  
OICCC (1970). "Viscosity of Chocolate-determination of

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1 Chocolate-determination of Casson yield value and Casson  
plastic viscosity", Analytical Methods, Analytical  
Methods of the Office International du Cacao et du  
Chocolat, pg. 10-E. The average of 3 ascending and 3  
5 descending values of Casson yield value or Casson  
Plastic viscosity were averaged together to provide the  
rheology values which are set forth in the examples.

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EXAMPLE 1

Sucrose and caprenin were combined at 20.78% fat and refined to 25 $\mu$ m. The refined sucrose/caprenin mixture was mixed in a 5 qt bowl using a Hobart N-50 mixer with an external bath temperature of 60°C on speed 1. 3.2% distilled deionized water (referenced to the sucrose/caprenin mass) was added to sucrose/caprenin mixture while mixing. Within 10 minutes, 0.28% fractionated lecithin (40% phosphatidyl choline) (referenced to the sucrose/caprenin mass) was added and the sucrose/caprenin/lecithin mixture continued mixing until the water was removed resulting in a paste labeled "special process sugar". To 625 g of special process sugar, the following ingredients were added: 160 g of spray-dried nonfat milk (the lactose was crystallized by agitating and incubating concentrated skim milk prior to spray drying), 50 g polydextrose, 70 g cocoa powder (coarse ground), 21 g cocoa butter, 0.2 g vanillin, 12 g caprenin. This mixture was refined to 25 $\mu$ m and then mixed on a Hobart N-50 mixer in a 5 qt Hobart bowl at 60° C. for 2 hr on speed 1. At the end of 4 hr, the nonstandardized chocolate paste was adjusted to 23.5% total fat with the addition of Caprenin and 0.5% fractionated lecithin (40% phosphatidyl choline). The particle size by micrometer of the final non-standardized chocolate was 25 $\mu$ m having a Casson yield value of 52 dyn/cm<sup>2</sup> and a Casson plastic viscosity of 50 poise. Compared to the leading solid milk chocolate bar, both calories and fat were reduced by 25%.

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EXAMPLE 2

The same process as Example 1 was followed except that the amounts of the ingredients differed slightly prior to the second refining. To 683 g special process sugar, the following ingredients were added: 170 g of lactose-crystallized spray dried nonfat milk, 27 g polydextrose, 73 g coarse-ground cocoa powder, 15 g cocoa butter, 0.2 g vanillin, 5 g caprenin. This mixture was refined and mixed as in Example 1 and then adjusted to 0.5% fractionated lecithin (40% phosphatidyl choline) and 20% total fat with the addition of caprenin. The final non-standardized chocolate had a micrometer particle size of 26 $\mu$ m, a Casson yield value of 130 dyn/cm<sup>2</sup> and a Casson plastic viscosity of 186 poise. Compared to the leading solid milk chocolate bar, calories were reduced 25% and the fat was reduced 36%.

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EXAMPLE 3

The special process was followed as explained in Example 1 except that the fats added to the sucrose were 81.6% cocoa butter and 18.4% milkfat. However, the additional ingredients (denoted as "others") were refined separately from the special process sugar and were as follows: 160 g lactose-crystallized spray-dried nonfat milk, 135 g chocolate liquor and 0.2g vanillin. The others were refined to 30 $\mu$ m. Then, 295 g others were combined with 691 g special process sugar and mixed as in Example 1 and then standardized to 23.5% fat using milkfat and 0.4% fractionated lecithin (40% phosphatidyl choline). The final milk chocolate had micrometer particle size of 30 $\mu$ m, a Casson yield value of 20 dyn/cm<sup>2</sup> and Casson plastic viscosity of 93 poise.

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**EXAMPLE 4**

The process for the special process sugar of Example 3 was followed as above except that the emulsifier added was diacetyl tartaric acid esters of mono- and diglycerides (DATEM). The others were as in Example 3 and were refined to 40 $\mu$ m and combined with the special process sugar as in Example 3. After mixing the chocolate as in Example 3, the chocolate was adjusted to 23.5% total fat with the addition of milkfat and to 0.44% total emulsifiers by the addition of fractionated lecithin (35% phosphatidyl choline). The final milk chocolate had a micrometer particle size of 39 $\mu$ m, a Casson yield value of 16 dyn/cm<sup>2</sup> and a Casson plastic viscosity of 114 poise.

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EXAMPLE 5

The special process sugar was produced as follows: 580 g sucrose was combined with 8 g milkfat, 135 g chocolate liquor and 87 g cocoa butter. This composition was refined to 25 $\mu$ m. The refined composition was treated as in Example 1 for processing of the special process sugar. The "others" were composed of 160 g lactose-crystallized spray dried nonfat milk, 16 g milkfat and 0.2 g vanillin. The "others" were refined to 40 $\mu$ m and combined with the special process sugar. After mixing as described in Example 1, the chocolate was adjusted to 20% total fat by addition of milkfat and to 0.4% fractionated lecithin (40% phosphatidyl choline). The milk chocolate's micrometer particle size was 39 $\mu$ m with a Casson yield value of 56 dyn/cm<sup>2</sup> and a Casson plastic viscosity of 184 poise.

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EXAMPLE 6

Special process sugar was prepared in Example 1 except that cocoa butter was used instead of Caprenin. The "others" were composed of 211 g lactose crystallized  
5 spray-dried nonfat milk, 0.3 g vanillin, 35 g milkfat and 20 g cocoa butter. These components were refined to 32 $\mu$ m and then combined with 698 g special process sugar and mixed as in Example 1. The finished white chocolate was adjusted to 24% total fat using cocoa butter and  
10 0.34% total emulsifiers with the addition of soya lecithin. The micrometer particle size of the final white chocolate was 32 $\mu$ m with a Casson yield value of 37 dyn/cm<sup>2</sup> and a Casson plastic viscosity of 82 poise.

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### EXAMPLE 7

Sucrose and cocoa butter were mixed to a ratio of 79/21 and were refined to 30 microns (by micrometer). The refined flakes were loaded in a Frisse DUC 200 5 conch. While mixing, water was added at 3.2% of the weight of refined flakes. Within 10 minutes, fractionated lecithin was added at 0.3% of refined flakes. The mixture was left mixing at 160°F until the water was removed and resulted in a mixture designated 10 as the special process sugar. In a separate mixer, chocolate liquor and lactose crystallized nonfat milk powder were combined, mixed and refined to 30 microns (by micrometer). The refined chocolate liquor and milk powder were combined with the special process sugar. 15 The combination was conched and standardized with anhydrous milkfat, cocoa butter and lecithin. The milk chocolate final total fat content was 26.4% having a Casson yield value of 15 dyn/cm<sup>2</sup> and a Casson plastic viscosity of 40 poise.

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### EXAMPLE 8

To 1215 g of granulated sucrose, 700 g of chocolate liquor was added, mixed and refined to 30 microns (by micrometer). The refined flakes were added to a 5 quart Hobart mixer. While mixing, 30 g water was added and after 10 minutes 5 g fractionated lecithin was added. The mixture was then mixed for 4 hr at 140 F. The semisweet chocolate was standardized to 24.4% fat resulting in a Casson yield value of 72 dyn/cm<sup>2</sup> and Casson plastic viscosity of 135 poise.

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EXAMPLE 9

Special process sugar was made according to Example 6 except that a polyglycerol ester was used instead of fractionated lecithin. The others were composed of 69 g lactose, 152 g nonfat milk powder, 115 g chocolate liquor and 2 g diacetyl tartaric acid ester of mono- and diglycerides (DATEM) and were mixed together and refined to 41 microns (by micrometer). The others were combined with 599 g special process sugar, mixed as in Example 1. The final milk chocolate was standardized to 25.0% fat having a Casson yield value of 5 dyn/cm<sup>2</sup> and a Casson plastic viscosity of 29 poise.

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1       The above preferred embodiments and examples are  
given to illustrate the scope and spirit of the present  
invention. The embodiments and examples described  
herein will make apparent, to those skilled in the art,  
5 other embodiments and examples. These other embodiments  
and examples are within the contemplation of the present  
invention. Therefore, the present invention should be  
limited only by the appended claims.

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1 WHAT IS CLAIMED IS:

1. A lowfat chocolate of full-fat texture comprising a fat and nonfat solids comprising nutritive carbohydrate sweetener, and an edible emulsifier, said chocolate containing 20-24.5% fat.

2. The lowfat chocolate according to Claim 1 wherein the nutritive carbohydrate sweetener is present in at least 35%.

3. The lowfat chocolate according to Claims 1 or 2 wherein the nutritive carbohydrate sweetener may be partially substituted with a sugar substitute.

4. The lowfat chocolate according to Claim 3 wherein the sugar substitute is a sugar alcohol, bulking agent or high potency sweetener or combination thereof.

5. The lowfat chocolate according to Claim 4 wherein the bulking agent is polydextrose.

6. The lowfat chocolate according to any one of Claims 2, 4, or 5 wherein the nutritive carbohydrate sweetener is present in the amount of at least 30%.

7. The lowfat chocolate according to any one of Claims 1-6 wherein the edible emulsifier is present in less than about 1%.

8. The lowfat chocolate according to any one of Claims 1-7 wherein the emulsifier is lecithin or DATEM or combination thereof.

9. The lowfat chocolate according to any one of Claims 1-8 wherein the chocolate has a moisture content of less than about 1%.

10. The lowfat chocolate according to any one of Claims 1-9 wherein the fat is Caprenin.

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1           11. The lowfat chocolate according to any one of  
Claims 1-10 wherein the chocolate contains milk fat.

          12. The lowfat chocolate according to Claim 11  
wherein the milkfat is present in less than 7%.

5           13. The lowfat chocolate according to any one of  
Claims 1-12 wherein the chocolate contains non-fat milk  
solids and/or non-fat cocoa solids.

          14. The lowfat chocolate according to Claim 13  
wherein the non-fat milk solids are present in a range  
10 from about 12% to about 20%.

          15. The lowfat chocolate according to any one of  
Claims 1-14 wherein the non-fat solids have  
substantially all particles in a size from about 1 to  
about 60 microns.

15          16. The lowfat chocolate according to any one of  
Claims 1-15 wherein the chocolate has a particle size of  
less than about 50 microns.

          17. The lowfat chocolate according to any one of  
Claims 1-16 wherein the chocolate has a yield value of  
20 less than about 2000 dynes/cm<sup>2</sup> and a plastic viscosity  
of less than about 200 poise, and the chocolate is used  
for extruding.

          18. The lowfat chocolate according to any one of  
Claims 1-16 wherein the sum of the values for the yield  
25 value and the plastic viscosity is less than 160, the  
chocolate being used as a coating.

          19. The lowfat chocolate according to any one of  
Claims 1-16 wherein the chocolate is used for molding  
solid bars and has a yield value of less than 200  
30 dyn/cm<sup>2</sup> and a plastic viscosity of less than 200 poise.



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1           20. The lowfat chocolate according to any one of  
Claims 1-19 wherein the chocolate is milk chocolate,  
skim milk chocolate, buttermilk chocolate, mixed dairy  
product chocolate, sweet chocolate, semi-sweet or  
5 bittersweet chocolate, white chocolate or non-  
standardized chocolate.

          21. The lowfat chocolate according to Claim 20  
wherein the milk chocolate contains greater than about  
35% by weight of a nutritive carbohydrate sweetener at  
10 least about 3.3% milkfat, less than about 1% moisture,  
at least about 8.6% milk solids-nonfat, at least about  
10% chocolate liquor and a maximum of about 1% edible  
emulsifier.

          22. The lowfat chocolate according to Claim 20  
15 wherein the skim milk chocolate contains greater than  
about 35% of a nutritive carbohydrate sweetener a  
maximum of about 4% milkfat, less than about 1% moisture  
by weight, at least about 12% milk solids-nonfat, at  
least about 10% chocolate liquor and a maximum of about  
20 1% edible emulsifier.

          23. The lowfat chocolate according to Claim 20  
wherein the buttermilk chocolate contains greater than  
about 35% of a nutritive carbohydrate sweetener, a  
maximum of about 4% milkfat, less than about 1%  
25 moisture, at least about 12% milk solids-nonfat and at  
least about 10% chocolate liquor and a maximum of about  
1% edible emulsifier.

          24. The lowfat chocolate according to Claim 20  
wherein the mixed dairy product chocolate contains  
30 greater than about 35% of a nutritive carbohydrate  
sweetener, about 0-24.5% milkfat, less than about 1%

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1 moisture, at least about 12% milk solids-nonfat, at  
least about 10% chocolate liquor and a maximum of about  
1% edible emulsifier.

25. The lowfat chocolate according to Claims 20  
5 wherein the sweet chocolate contains greater than about  
35% of a nutritive carbohydrate sweetener, about 0-12%  
milkfat, a maximum of about 12% milk solids-nonfat,  
about 15-35% chocolate liquor, and a maximum of about 1%  
edible emulsifier.

10 26. The lowfat chocolate according to Claim 20  
wherein the semisweet or bittersweet chocolate contains  
greater than about 35% of a nutritive carbohydrate  
sweetener, about 1-12.0% milkfat, a maximum of about 1%  
moisture, a maximum of about 12% milk solids-nonfat, at  
15 least about 35% chocolate liquor and a maximum of about  
1% edible emulsifier.

27. The lowfat chocolate according to Claim 20  
wherein the white chocolate contains about 35-55% of a  
nutritive carbohydrate sweetener and with a fat content  
20 of 23.5-24.5%, about 3.5-4.5% milkfat, a minimum of  
about 10.5% milk solids-nonfat, about 20.0-21.0% cocoa  
butter, and a maximum of about 1% edible emulsifier.

28. The lowfat chocolate according to Claim 20  
wherein the non-standardized chocolate contains greater  
25 than about 35% by weight of a nutritive carbohydrate  
sweetener and a maximum of about 1.0% moisture.

29. The lowfat chocolate according to any one of  
Claims 3-28 wherein the chocolate is a low-fat, reduced  
calorie chocolate containing a mixture of fats, reduced  
30 calorie fats or a combination thereof.

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1           30. The lowfat chocolate according to any one of  
Claims 1-29 wherein the chocolate is an edible  
composition.

          31. The lowfat chocolate according to Claim 30  
5 wherein the edible composition is a confection, baking  
chocolate or a chocolate chip.

          32. A process for making a low fat chocolate of  
full-fat texture comprising the following steps:

          (a) mixing a nutritive carbohydrate sweetener  
10 with a fat to form a sweetener/fat mixture;

          (b) refining said mixture of step (a); or

          (a) refining a nutritive carbohydrate sweetener  
in a dry mill;

          (b) mixing a fat with said refined nutritive  
15 carbohydrate sweetener of step (a) to form a sweetener/  
fat mixture;

          (c) blending the refined mixture obtained in step  
(b) with a minor amount of water, said water being  
present in amounts effective to dissolve the particles  
20 having a size less than about 10 microns in said  
sweetener;

          (d) adding a surfactant to the mixture of step  
(c);

          (e) agitating and drying the mixture of step (d)  
25 to obtain a lowfat nutritive carbohydrate sweetener/fat  
paste; and

          (f) standardizing the paste of step (e) to the  
specified fat level.

          33. A process for making a lowfat reduced  
30 calorie chocolate of full-fat texture comprising the  
following steps:

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- 1 (a) mixing a nutritive carbohydrate sweetener  
with a mixture comprising fat and reduced calorie fat to  
form a sweetener/fat mixture;  
(b) refining said mixture of step (a); or  
5 (a) refining a nutritive carbohydrate sweetener  
in a dry mill;  
(b) mixing a fat and reduced calorie fat with  
the refined nutritive carbohydrate sweetener of step (a)  
to form a sweetener/fat mixture;  
10 (c) blending the refined mixture obtained in step  
(b) with a minor amount of water, said water being  
present in amounts effective to dissolve the particles  
having a size less than about 10 micrometers in said  
sweetener;  
15 (d) adding a surfactant to the mixture of step  
(c);  
(e) agitating and drying the mixture of step (d)  
to obtain a lowfat sweetener/fat paste; and  
(f) standardizing the paste of step (e) to the  
20 specified fat level.
34. A process for making a low fat chocolate of  
full fat texture comprising:  
(a) preparing a supersaturated solution of a  
nutritive carbohydrate sweetener in water that is  
25 substantially free of crystals;  
(b) cooling said solution of step (a) and adding  
to said cooled supersaturated solution 5-20% fat based  
on the dry weight of the nutritive carbohydrate  
sweetener under conditions effective to retard  
30 crystallization;

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- 1           (c) shearing the mixture of (b) to initiate  
crystallization;
- (d) adding a surfactant to the mixture of step  
(c);
- 5           (e) agitating and drying the product of step (d)  
under conditions effective to complete crystallization  
and to substantially remove all of the water, thereby  
obtaining a lowfat nutritive carbohydrate sweetener/fat  
paste; and
- 10          (f) standardizing the solution of step (e) to a  
specified fat level.
35. A process for making a low fat chocolate of  
full fat texture comprising the following steps:
- (a) refining a nutritive carbohydrate sweetener  
15 in a dry mill and removing from said refined sweetener  
particles whose size is less than 10 microns;
- (b) adding a fat to the product of step (a) to  
form a sweetener/fat mixture;
- (c) blending the mixture in step (b) with a  
20 minor amount of water, said water being present in  
amounts effective to dissolve the particles having a  
size less than about 10 microns in said mixture;
- (d) adding a surfactant to the mixture of step  
(c);
- 25          (e) agitating while drying the mixture of step  
(d) to obtain a low fat nutritive carbohydrate  
sweetener/fat paste; and
- (f) standardizing the paste of step (e) to the  
specified fat level.

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1           36. A process for making a lowfat reduced  
calorie chocolate of full-fat texture comprising the  
following steps:

5           (a) preparing a supersaturated solution of a  
nutritive carbohydrate sweetener in water that is  
substantially free of crystals;

          (b) cooling said solution of step (a) and adding  
to said cooled supersaturated solution a mixture of fat  
and reduced calorie fat, under conditions effective to  
10 retard crystallization the weight of said mixture being  
5-20% of the dry weight of the nutritive carbohydrate  
sweetener;

          (c) shearing the mixture of step (b) to initiate  
crystalization;

15           (d) adding a surfactant to the mixture of step  
(c);

          (e) agitating and drying the product of step (d)  
under conditions effective to complete crystallization  
and substantially remove all of the water, thereby  
20 obtaining a lowfat nutritive carbohydrate/reduced  
calorie fat mixture; and

          (f) standardizing the solution of (e) to a  
specified fat level.

25           37. A process for making a lowfat reduced  
calorie chocolate of full fat texture comprising the  
following steps:

          (a) refining a nutritive carbohydrate sweetener  
in a dry mill and removing from said refined sweetener  
particles whose size is less than 10 microns;

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1 (b) adding a mixture comprising fat and reduced  
calorie fat to the product of step (a) to form a  
sweetener/reduced calorie fat mixture;

5 (c) blending the mixture in step (b) with a  
minor amount of water, said water being present in  
amounts effective to dissolve the particles having a  
size less than about 10 microns in said mixture;

(d) adding a surfactant to the mixture of step  
(c);

10 (e) agitating while drying the mixture of step  
(d) to obtain a lowfat fat nutritive carbohydrate  
sweetener/reduced calorie fat paste; and

(f) standardizing the paste of step (e) to the  
specified fat level.

15 38. The process according to any one of Claims  
32-37 wherein the fat or reduced calorie fat is present  
in the amount of about 10-24% wt. of said sweetener/fat  
paste of step (e) and said paste contains a moisture  
content of less than about 0.2%.

20 39. The process according to any one of Claims  
32-38 wherein said surfactant is added in an amount of  
about 0.1-0.5% and is lecithin, a fractionated lecithin,  
diacetyl tartaric acid esters of mono- and diglycerides,  
polyglycerol esters or mixtures thereof.

25 40. The process according to any one of Claims  
32-39 wherein substantially all of the particles in said  
chocolate are reduced to about less than 50 microns.

30 41. The process according to any one of Claims  
32-40 wherein the final fat content of said chocolate is  
from 20-24.5% by weight total fat.

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1           42. The process according to any one of Claims  
32-41 wherein said water of step (c) is added in an  
amount of at least about 10% of the sugar weight.

5           43. The process according to any one of Claims  
32-42 which additionally comprises the following steps  
subsequent to step (e) and prior to step (f):

          (e<sub>1</sub>) adding at least one size-reduced  
ingredient selected from the group consisting of low  
calorie fat, sugar substitute, cocoa solids, non-fat  
10 milk solids, cocoa powder, chocolate liquor, lactose,  
milkfat, whole milk powder, non-fat milk solids,  
anhydrous milkfat or mixtures thereof to the paste of  
step (e), said ingredient being selected to provide the  
desired type of chocolate, and

15           (e<sub>2</sub>) conching or liquefying the paste of  
step (e<sub>1</sub>).

          44. The process according to Claim 43 wherein  
said non-fat milk solids are pretreated to compact the  
structure and crystallize a substantial portion of the  
20 lactose present in said milk solids.

          45. The process according to Claim 44 wherein  
said pretreated non-fat milk solids have over 30%  
lactose crystallization and a bulk density over 0.7  
g/ml.

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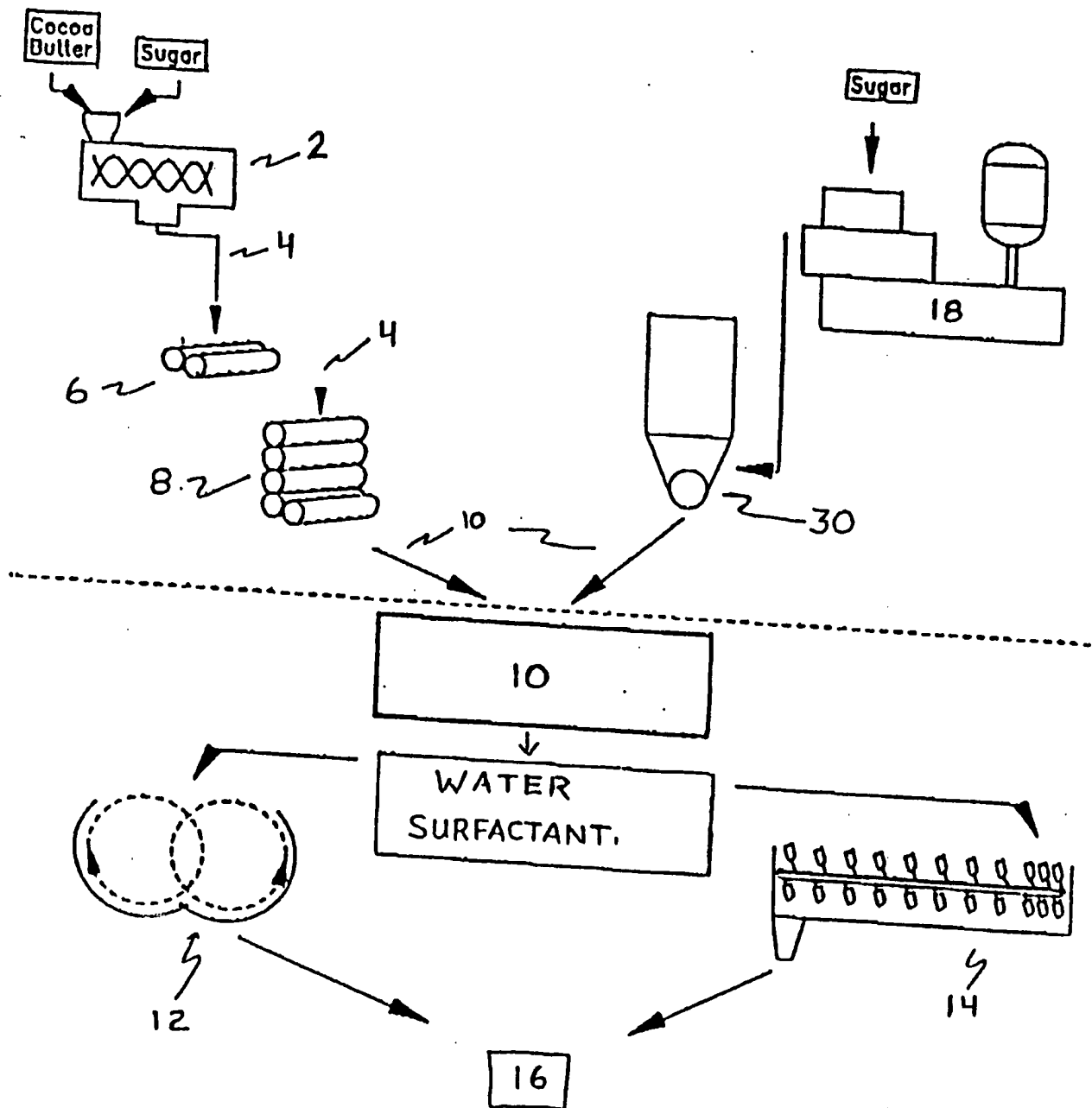


FIG. 1

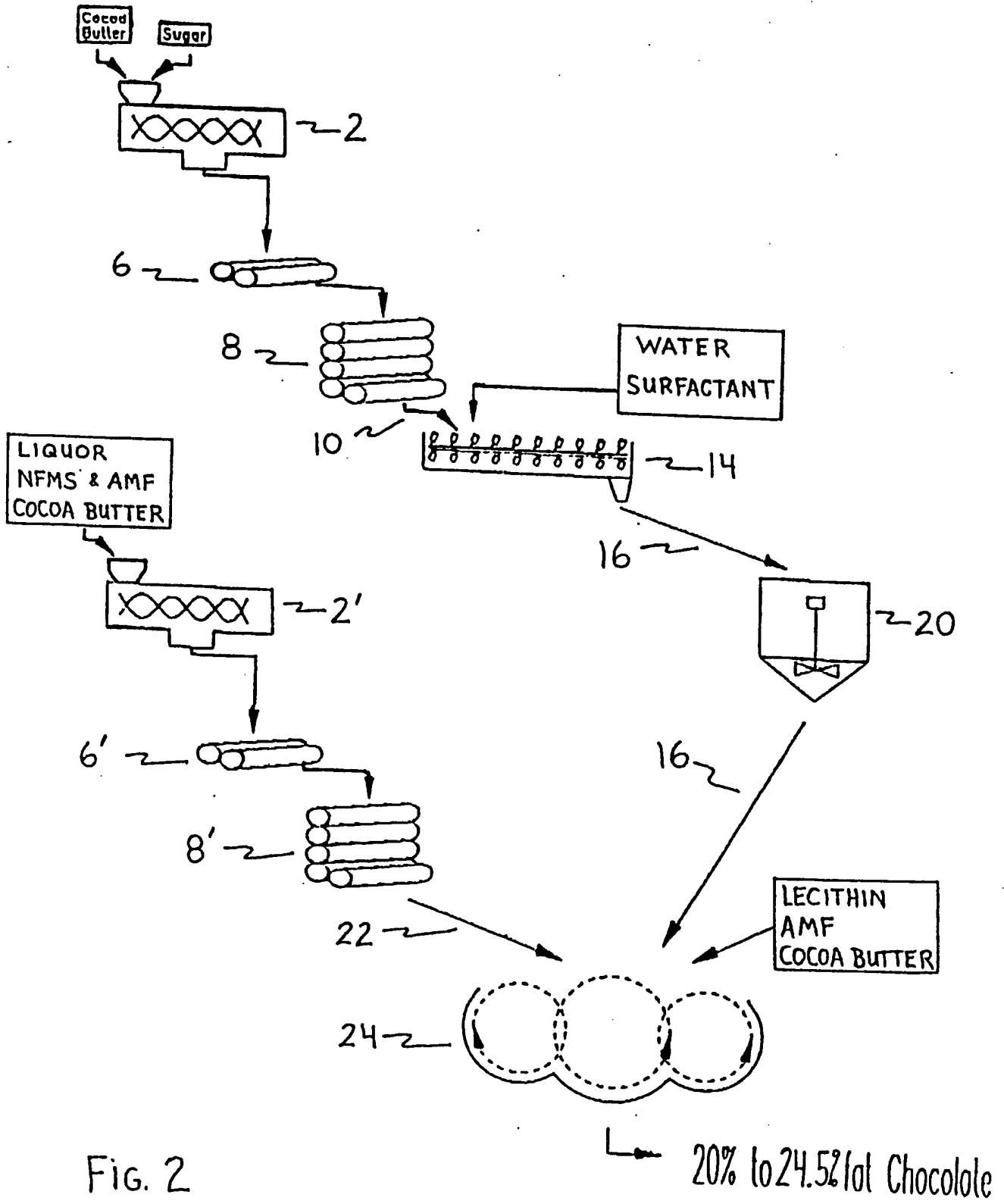


Fig. 2

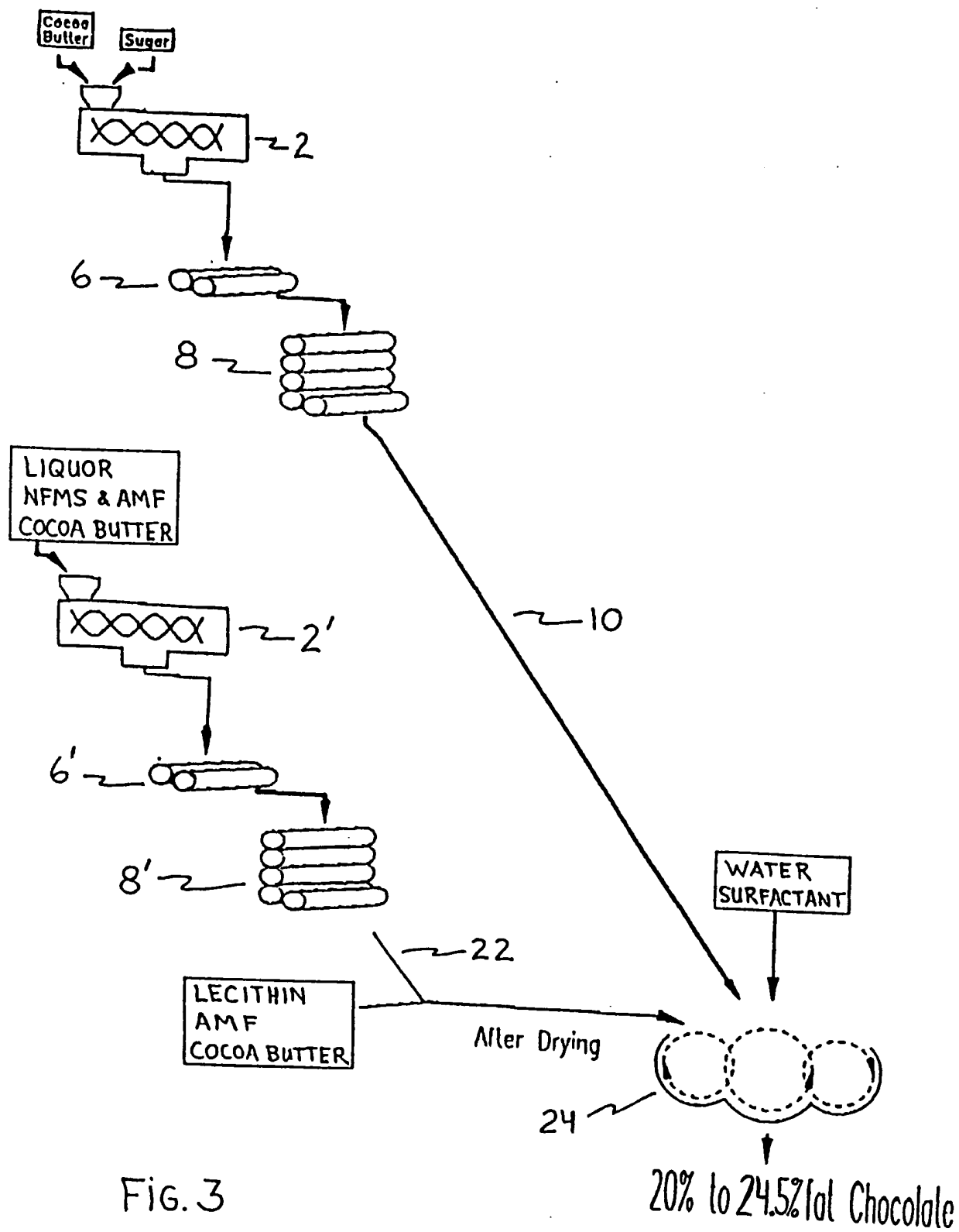


FIG. 3

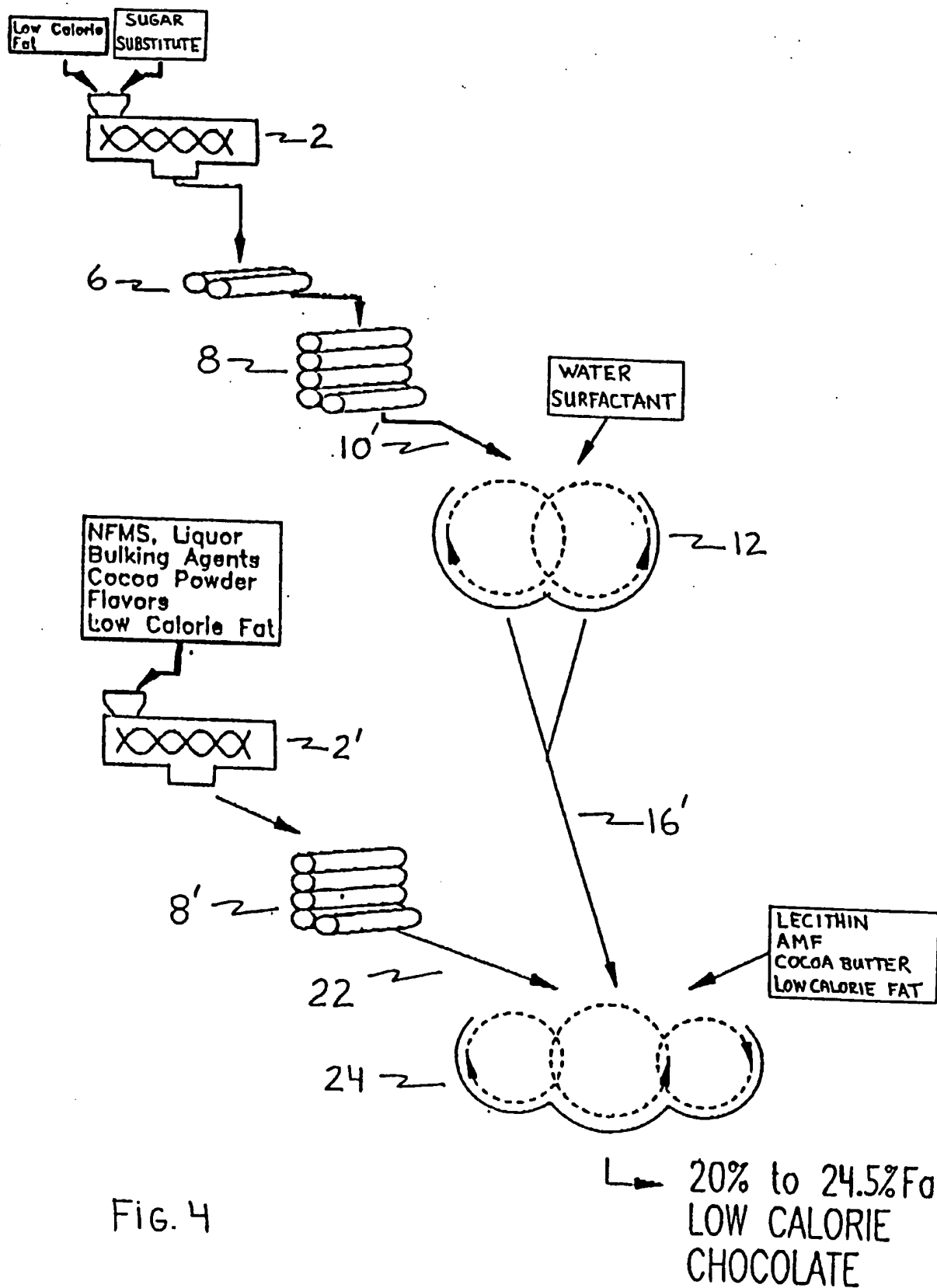
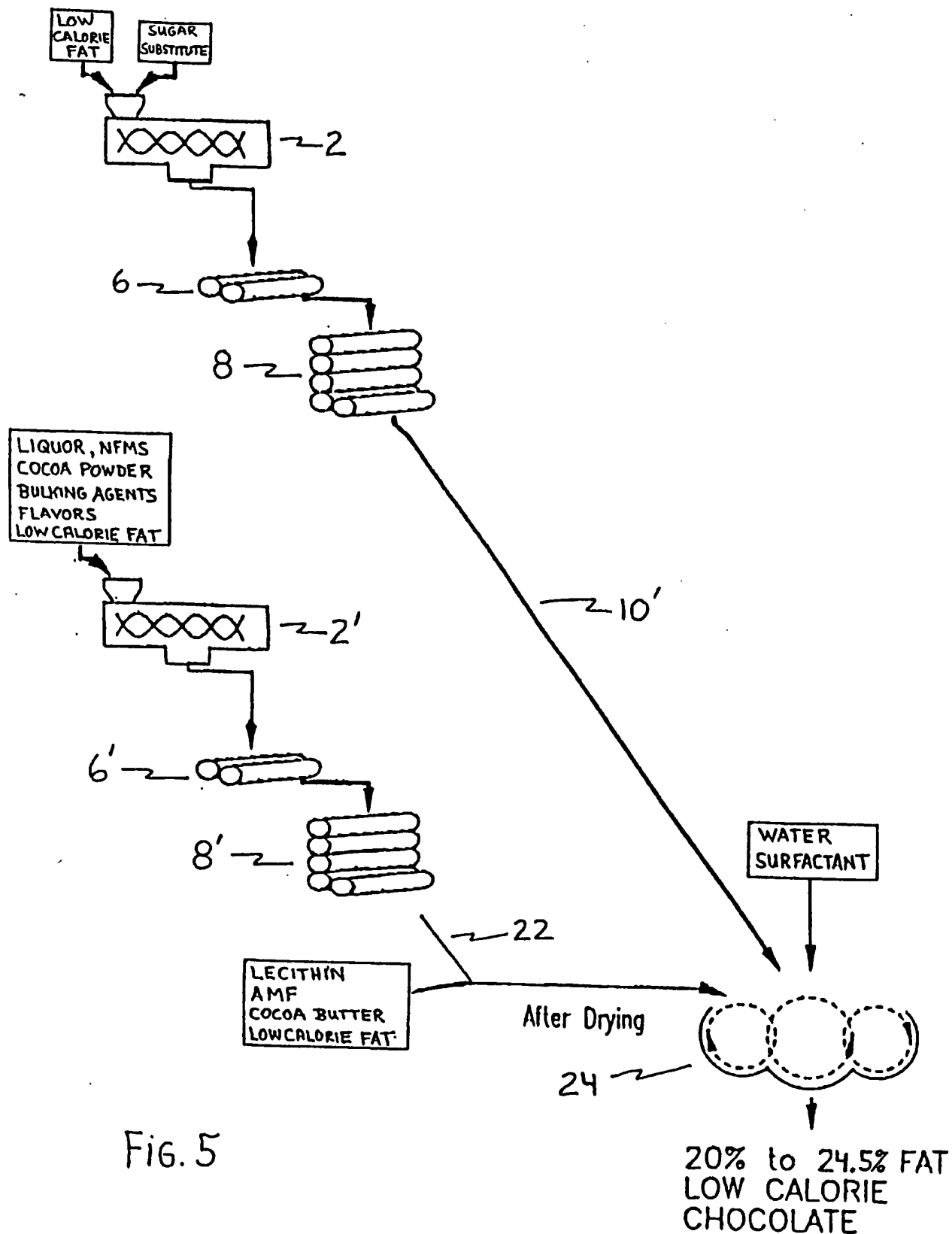


FIG. 4



## INTERNATIONAL SEARCH REPORT

 International application No.  
PCT/US93/10135
**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(5) : A23L 1/236, 1/09; A23D 7/00, 9/00; A23G 3/00

US CL : 426/548, 572, 607, 631, 658, 660

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 426/103, 306, 548, 572, 584, 601, 602, 607, 613, 631, 658-660, 804

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KIRK-OTHMER

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US, A, 4,081,559 (Jefferey et al) 28 March 1978, see the entire document.	1-6 --- 38
Y	US, A, 4,925,695 (Martin, Jr. et al) 15 May 1990, see entire document.	32-38
Y	US, A, 5,080,923 (Martin, Jr. et al) 14 January 1992, see entire document.	32-38
Y	Kirk-Othmer Encyclopedia of Chemical Technology, Third Edition, Volume 6, New York, 1979, "Chocolate and Cocoa", pages 1-18, especially pages 12-14.	32-38

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be part of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 16 December 1993	Date of mailing of the international search report 19 JAN 1994
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer <i>Debbie Wilber</i> Michael W. Ball Telephone No. (703) 308-4788

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US93/10135

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 7-31 and 39-45  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:  
Telephone Practice  
Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US93/10135

## BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

This ISA found multiple inventions as follows:

I. Claims 32, 33, 35 and 37, drawn to one method species of making lowfat chocolate, classified in Class 426, Subclass 660.

II. Claims 34 and 36, drawn to a second method species of making lowfat chocolate, classified in Class 426, Subclass 660.

The inventions of groups I and II lack Unity of Invention under PCT Rule 13.2 as the two methods are not linked by a single inventive concept. The method of Group II does not require the refining or dissolving steps of Group I, and the method of Group I does not require the supersaturated solution of Group II. Note also 37 CFR 1.475.

Claims 1-31 and 38-45 will be examined with the elected group.